RUN 2B M&S AND MANPOWER PLAN FOR FY02

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INTRODUCTION

The Run 2b project leaders were asked to give an estimate for what they would like to spend in FY02. The estimate was to include:

1. A short description of what the project hopes to accomplish in FY02.
2. An estimate of how much M&S money (Materials & Services) is needed in FY02
3. An estimate of how many FTE's and the type of FTE (Physicist, Engineer, Drafting, Technician, Computer Professional, etc...) the project will need.
4. Where possible, specify the names of the people expected to work on the project and how much time they are expected to spend on it.

Table 1 shows a summary of the M&S and Labor needs of each project in Run 2B. Table 2 shows a list of the manpower needed for each project.

Project	Leader	Total	M&S	Labor	Phys	Engr	Techs.	Draft	CP
Slip Stacking & MI Beam loading	Steimel	570	160	4.1	1.15	1.65	1.3	0	0
8GeV Antiproton Transfers	Lebedev	385	90	2.95	1.3	0.55	0.6	0	0.5
AP2 & Debuncher Aperture	Gollwitzer	650	90	5.6	0.9	1.5	2.2	0	1
Solid Lens R&D	Morgan	430	130	3	0.5	1	0.75	0.75	0
Accumulator Cooling	Derwent	100	0	1	0.8	0.2	0	0	0
Recycler Electron Cooling	Nagitsev	4100	2445	16.55	8.5	2.8	3.75	1	0.5
Debuncher Lattice Upgrades	Werkema	100	0	1	1	0	0	0	0
Linac Ion Source	Moehs	533	108	4.25	2	0	2.25	0	0
TEV Tune shift compensation	Shiltsev	2780	930	18.5	9	5.5	2.5	1	0.5
TEV. Beam Dynamics	Tan	70	10	0.6	0.5	0	0.1	0	0
Liquid Lens R&D	Leveling	230	200	0.3	0.2	0	0.1	0	0
Total		9948	4163	57.85	25.85	13.2	13.55	2.75	2.5

Table 1

Name	Dept.	Type	Total	Slip Stack	Pbar Trans.	AP2 Aper.	Solid Lens	Acc. Cool.	RR Cool.	Deb. Lat.	Ion Src.	BBC	TEV BD.	Liq. Lens.
CP Prof	Controls	CP	1		0.5							0.5		
Kramper	Controls	CP	0.5						0.5					
Budlong	Pbar	CP	1			1								
MS Drafter	MS	Draft	2						1			1		
O'Brien	MS	Draft	0.25				0.25							
Popper	MS	Draft	0.5				0.5							
Fuerst	Cryo	Engr	1									1		
Martinez	Cryo	Engr	0.5									0.5		
Hively	EE	Engr	0.5									0.5		
Pfeffer	EE	Engr	0.5									0.5		
Saewert	EE	Engr	1.8						0.8			1		
Hurh	MS	Engr	0.5				0.5							
Leibfritz	MS	Engr	1						1					
McGee	MS	Engr	0.5						0.5					
Ryan	MS	Engr	0.25				0.25							
Anderson	Pbar	Engr	0.75			0.75								
Peterson	Pbar	Engr	0.75			0.75								
Tang	PPD	Engr	0.25				0.25							
Berenc	RF&I	Engr	0.25	0.25										
Chase	RF&I	Engr	0.1	0.1										
Crisp	RF&I	Engr	1									1		
Dey	RF&I	Engr	0.35	0.35										
Meisner	RF&I	Engr	0.1	0.1										
Pasquinelli	RF&I	Engr	0.2					0.2						
Reid	RF&I	Engr	0.1	0.1										
RFI Engr	RF&I	Engr	1.05		0.55				0.5					
Wildman	RF&I	Engr	1									1		
Steimel	TEV	Engr	0.75	0.75										
McLachlan	AP	Phys	0.25	0.25										
Bishofberger	BBC	Phys	1									1		
Kuznetsov	BBC	Phys	1									1		
Physicist	BBC	Phys	3									3		
RA	BBC	Phys	2									2		
Shiltsev	BBC	Phys	1									1		
Zhang	BBC	Phys	1									1		
Burov	EC	Phys	1						1					
Crawford	EC	Phys	1						1					
Grad student	EC	Phys	1						1					
Kroc	EC	Phys	0.5						0.5					
Nagaitsev	EC	Phys	1						1					

Table 2.

Name	Dept.	Type	Total	Slip Stack	Pbar Trans.	AP2 Aper.	Solid Lens	Acc. Cool.	RR Cool.	Deb. Lat.	Ion Src.	BBC	TEV BD.	Liq. Lens.
Shemyakin	EC	Phys	1						1					
Tupikov	EC	Phys	1						1					
Warner	EC	Phys	1						1					
Koba	MI	Phys	0.75	0.75										
Kourbonis	MI	Phys	0.15	0.15										
Derwent	Pbar	Phys	0.8					0.8						
Gollwitzer	Pbar	Phys	0.7			0.7								
Harms	Pbar	Phys	0.2		0.2									
Lebedev	Pbar	Phys	1		0.6	0.2				0.2				
Leveling	Pbar	Phys	0.35				0.25							0.1
Morgan	Pbar	Phys	0.35				0.25							0.1
Sondgeroth	Pbar	Phys	0.5		0.5									
Werkema	Pbar	Phys	0.8							0.8				
Dudnikov	PS	Phys	1						0.5		0.5			
Moehs	PS	Phys	1								1			
Schmidt	PS	Phys	1						0.5		0.5			
Tan	TEV	Phys	0.5										0.5	
Carlson	EC	Tech	0.5						0.5					
EE tech	EE	Tech	2.5						1			1.5		
Frett	MS	Tech	0.25						0.25					
Kellett	MS	Tech	1						1					
Kelly	MS	Tech	0.85				0.75							0.1
MS Tech	MS	Tech	0.95			0.2					0.25	0.5		
Nelson	MS	Tech	1						1					
Dilday	Pbar	Tech	1			1								
Obie	Pbar	Tech	0.2		0.2									
Pbar Tech	Pbar	Tech	1			1								
Hren	PS	Tech	1								1			
Wendt	PS	Tech	1								1			
Holm	RF&I	Tech	0.15	0.15										
Olson	RF&I	Tech	0.5									0.5		
RF&I Tech	RF&I	Tech	0.4		0.4									
VanBogaert	RF&I	Tech	0.15	0.15										
Zifko	RF&I	Tech	0.15	0.15										
Koch	TEV	Tech	0.6	0.5									0.1	
McCormack	TEV	Tech	0.35	0.35										
Total			57.9	4.1	2.95	5.6	3	1	16.6	1	4.25	18.5	0.6	0.3

Table 2. *(continued)*

SLIP STACKING

We have decided that it would be easier to adjust the grid bias than add power to the solid state drivers. We still are not 100% sure that the tubes can handle the beam loading compensation current, but if they can't, the modifications would require at least a year of design and studies before we would spend money on it.

By the end of FY02, we hope to demonstrate high intensity slip stacking in the Main Injector. In order to succeed with this goal, we will commission a digital beam loading compensation system that is capable of close to 40dB of beam loading reduction at the fundamental frequency and 20dB reduction of the revolution harmonics. The RF power supply controls will be modified to handle the large reactive current required for beam loading compensation. Also, studies on the operational mechanics of slip stacking will continue including LLRF control, injection, coalescing, and longitudinal emmitance preservation.

Cost Estimate

Digital Beam Loading Compensation $120k
RF power supply upgrades $40k

Labor

- 1.65 Engineers (Beam Loading Compensation Design/Commission, RF Power Supply Design/Commission, RF Control Upgrades)
- 1.15 Physicists (Slip Stacking Mechanics Commissioning, Slip Stacking/Beam Loading Simulations)
- 1.3 Technicians (Beam Loading Compensation CAD, construction, and installation, RF Power Supply modifications and installation, RF Control modifications and installation)

Labor Breakdown

Engineering	Physics	Technical
Jim Steimel 75%	Kiyomi Koba 75%	Ken Koch 50%
Joe Dey 35%	Jim McLachlan 25%	Jim McCormack 35%
John Reid 10%	Ionis Kourbonis 15%	John Holm 15%
Tim Berenc 25%		John VanBogaert 15%
Brian Chase 10%		Rick Zifko 15%
Keith Meisner 10%		

8GeV Antiproton Transfers

There are four goals we want to meet by the end of FY02:

1. Installation of the new AP3 lattice which will require the reconnection of a number of quadrupole supplies plus the addition of a number of quadrupole power supply shunts

M&S:	$40k	for electrician time, shunts, and cables.
Physicists:	Lebedev	@ 0.2 FTE,
	Harms	@ 0.2 FTE
Technicians:	Obie's crew	@ 0.2 FTE

2. The commissioning of a Main Injector 8 GeV antiproton injection damper. This system would allow for lower tolerances on the tune-up for the beamline orbit which might result in a faster shot setup time. This system would also reduce emittance dilution due to random power supply oscillations in the transfer-line. This system would use most of the hardware that is in place for the Main Injector narrowband n-Q transverse dampers.

M&S:	$20k	for low level electronics and instrumentation
Physicists:	Lebedev	@ 0.2 FTE
Engineers:	RF&I Engr	@ 0.3 FTE
Technicians:	RF&I Tech	@ 0.2 FTE

3. On-line modeling of the Antiproton Source transfer lines will be upgraded. On-line modeling is crucial for accurate orbit correction and lattice measurements. The present lattice files for the Pbar transfer lines contain a large amount of errors and out-of-date information. These lattice files need to be corrected. Also the interface between the on-line data and lattice modeling programs needs to be upgraded.

Physicists:	Sondgeroth	@ 0.5 FTE
Comp. Prof.	Controls	@ 0.5 FTE

4. The Accumulator quadrupole BPM will be recommissioned. This might require the redesign of the BPM itself based on the CERN design that was presented at this summer's PAC conference. The electronics will also be upgraded. The quadrupole BPM will allow lattice mismatches to be measured.

M&S	$20k	
Physicists:	Lebedev	@ 0.2 FTE
Engineers:	RF&I Engr	@ 0.25 FTE
Technicians:	RF&I Tech	@ 0.2 FTE

AP2 AND DEBUNCHER APERTURE UPGRADES

There are three goals we would like to achieve by the end of FY02:

1. Finish the installation of the ten moveable quad stands in the Debuncher. The parts for the quad stands were purchased in FY01 and fabrication will be completed by the end of FY01. The installation will require controls and connection to the control system. The motorized quad stands will be installed in the three straight sections of the Debuncher to control the orbit locally around the small apertures found in the cooling systems and the RF cavities. In addition to the quad stands, we started the fabrication of a portable alignment fixture for the non-motorized quads that would permit the rapid re-alignment of Debuncher quads during short tunnel accesses. In FY02, we would like to move a number of non-motorized quads in the arcs of the Debuncher to control the orbit in the Debuncher arcs.

M&S	$10k for controls for the moveable quad stands	
Physicists	Gollwitzer	@ 0.3 FTE
	Vander Meulen	@ 0.3 FTE
Technicians:	Mech. Support Techs	@ 0.2 FTE

2. Complete a major portion of the electronics for a closed orbit BPM system for the Debuncher and upgrade the DAQ system for the AP2 transfer line

M&S	$45k for the DAQ units	
	$25k for the analog electronics	
	$10k for internet structure	
Physicists	Gollwitzer	@ 0.4 FTE
Engineers	Peterson	@ 0.75 FTE
	Anderson	@ 0.75 FTE
Technicians	Dilday	@ 1.0 FTE
	Pbar Tech.	@ 1.0 FTE
Comp. Prof.	Budlong	@ 1.0 FTE

3. Re-tune the AP2 lattice.

Physicists	Lebedev	@ 0.2 FTE

<u>SOLID LITHIUM LENS R&D</u>

The high gradient solid lens efforts will focus on three areas during FY '02:

1. Design and fabrication of prototype high gradient lenses.
2. Fatigue testing of diffusion bonded joints.
3. Simulation of collection lens optics to evaluate possible design changes.

It is hoped that prototype #1 under construction presently will be completed and tested during the early part of the fiscal year. It is also hoped that a second prototype design will be developed (including ANSYS simulation), constructed and tested by the end of the fiscal year. In parallel, efforts to fatigue test the critical central joint of any diffusion bonded lens will continue. Although testing costs at ANL have already been allocated, costs will be incurred for preparation of test samples and analysis of failed samples. It is hoped to have this work completed early in the fiscal year. Finally work will continue during FY '02 to simulate target hall optics using various codes in order to evaluate possible future lens designs' effects on p-bar yield.

M&S Budget Projection.

Completion of the first prototype effort is estimated to consume approximately 28 k$ of M&S. The second prototype effort is estimated to require approximately 43 k$. Fatigue testing is estimated to incur another 45 k$ during FY '02. Due to the R&D nature of the project, it is recommended to use a rather higher contingency on these projections of about 20%. M&S for simulation studies is probably minimal (negligible). Thus the total (including contingency) M&S budget projection is 130 k$.

FTE Needs (effort averaged over one year).

Physicist	Morgan	@ 0.25 FTE
	Leveling	@ 0.25 FTE
Engineer	Hurh	@ 0.50 FTE
	Shultz	@ 0.25 FTE
	Tang	@ 0.25 FTE
Technicians	Kelly	@ 0.75 FTE
Drafting	Popper	@ 0.50 FTE
	O’Brien	@ 0.25 FTE

RECYCLER ELECTRON COOLING

Although electron cooling is well understood, the Recycler application represents a major step in beam energy, to 8 GeV from less than 1 GeV. The step is large enough that the high voltage generator, beam transport, and cooling region all require extension of the state of the art. Therefore, about two years (as of May, 2001) of research and development activity are likely to precede introduction of any electron cooling equipment into the Recycler.

The R & D phase of the project has the following goals:

1. optimized system parameter set (finished);
2. a reliable 4.3 MV electrostatic power supply;
3. electron beam gun, collector and transport system to sustain a recirculating current of at least 0.5 A;
4. precise matching from discrete-element beam transport to continuous cooling region solenoid;
5. a 20 m cooling section with uniform axial magnetic field with precision such that p-bar transverse angles are ? 10^{-4};
6. beam instrumentation and control to maintain alignment and equal mean velocity of electron and p-bar beams to precision ?10^{-4}, to measure beam angular spread and position, to determine neutralization, *etc*.

The laboratory developments are now being carried out in the downstream end of the Wideband Lab experimental area at Fermilab. There is sufficient space at Wideband to carry out the development work envisioned for the Recycler cooling project. The goal of the development program is cooling-system hardware ready for installation into the Recycler. The remainder of the work constitutes Accelerator Improvement Projects of moderate scale.

The basic tasks are:

1. Architectural design and civil construction of an enclosure for the high voltage generator and an interconnection tunnel to the MI tunnel for the electron beam transport. The work on this task has already started by Fermilab's FESS;
2. Installation of a Recycler lattice insertion for the cooling region. This task is almost finished. The Recycler lattice suitable for the electron cooling system exists. However, some p-bar trim magnets, diagnostics, and vacuum equipment will have to be installed upstream and downstream of the cooling section at the time of the cooler installation;
3. Installation of cooling section and electron beam transport channels;
4. Commissioning of the cooling system;
5. Construction of a p-bar transport line from the Accumulator to the Recycler (AP5 line);
6. Incremental improvements to p-bar Source to double throughput.

Electron Cooling Schedule

Project Milestone	**Start Date**	**Finish Date**	**Duration**
Commission U-Bend	3/01	12/01	10 months
500 mA, 1 hour (U-bend)		by 12/31/01	
FESS Title 2 begins		10/01/01	
Switch Over to Full Beamline	1/02	3/02	3 months
MI-31 bid out		02/01/02	
Commission Beamline	3/02	1/03	11 months
500 mA, 1 hour, beam properties		by 01/31/03	
Build MI-31 Enclosure	4/02	10/02	7 months
Push-Pipe	6/02	8/02	3 months
(Shutdown MI)	7/02	8/02	1 month??
Disassemble @ Wideband	2/03	4/03	3 months
Install Pelletron @ MI-31	3/03	6/03	4 months
Shutdown MI	8/03	11/03	4 months
Install RR Components	8/03	10/03	3 months
Install Transferline	9/03	11/03	3 months
Commission E-Cool	12/03		

M&S Budget	
MI-31 FESS (AIP)	1266
WideBand (R&D) Cooling Section	342
WideBand (R&D) Supply and return lines	546
General	291
Total	2445

Physicists	Engineers	Technicans	Drafters	Comp. Prof.
Nagaitsev 100%	Leibfritz 100%	Carlson 50%	MS Draft. 100 %	Kramper 50%
Shemyakin 100%	Saewert 80%	Nelson 100%		
Crawford 100%	McGee 50%	Kellett 100%		
Warner 100%	RFI Engr. 50%	Frett 25%		
Tupikov 100%		EE techs. 100%		
Burov 100%				
Schmidt 50%				
Dudnikov 50%				
Kroc 50%				
Grad. 100%				

TEVATRON BEAM-BEAM COMPENSATION WITH ELECTRON BEAMS

Accomplishments Expected in FY02

The BBC R&D project at Fermilab will need to pursue a number of paths in FY02 and beyond. These tasks are listed below in descending order of priority. Depending on the success of the BBC demonstration experiment, the second TEL has be build and installed in the Tevatron. The rest of this section outlines the scope and justification for these priorities.

A. Tevatron beam studies with TEL

Beam studies in the Tevatron with the first TEL will be focused on demonstration of successful e-lens operation, that is the TEL shifts pbar/p tunes by some 0.005-0.01 and do not worsen significantly the luminosity lifetime. The studies include:

1. High current TEL tune shift manipulation with a single proton or pbar bunch out of 36 bunches under Run II conditions (rep. rate of 48 kHz, pulse width of about 100-800 nsec, e-current upto 3-5A): control and tuning of e-pbar “head-on” collisions; pbar tune shift vs. current; effect on pbars/protons vs. e-current; p/pbar tune shift vs. e-beam size, shape; ion clearing effects on pbar and proton beams.
2. Studies of the p/pbar losses (lifetimes) and emittance growth while under impact of the TEL: understanding the most important parameters and factors, e.g. effects of e-beam size, shape, alignment, stability, etc.
3. Search for e-beam impedance manifestation
4. The first studies of non-linear e-pbar beam-beam effects (single bunch operation, Gaussian e-current profile, e-current 0-2 A): topics to be investigated will depend on theory predictions.

As item 1 topics are partly studied, realization of item 2 will be considered as a viability demonstration of the linear tune shift compensation with electron beam. About 20 dedicated Tevatron beam studies shift are required to accomplish items 1 and 2. Fabrication of the second TEL will be started immediately afterwards, and later the second TEL will be installed in another Tevatron warm straight section. The decision is expected to be made before the end of 2001.

B. Fabrication of the Second TEL

After the decision is made, the second TEL fabrication and purchase of necessary equipment will begin. Basically, the first TEL will be duplicated with some minor modifications. It is anticipated that, in contrast with the first TEL, some major equipment will not be available on loan from the Fermilab Beams Division. Therefore, more will be spent on purchasing of “big items”, such as low- and high-current HV power supplies for the gun, modulator and collector ($110 K total), power supplies and parts for the HV modulator ($300 K) in addition to fabrication of the 2^{nd} and spare guns (70 k$), collectors (60k$), vacuum system (60k$), cryo equipment (70k$). The cost of these items will be evenly spread over FY02 and FY03. IHEP(Protvino) is expected to fabricate magnetic system for the second TEL within the same cost as the first one (some 330k$ - all in FY02), but much quicker (7-8 months instead of ten months).

As with the 1st TEL, the 2nd TEL will be tested in the E4R building prior to installation In the tunnel. It will require about 40K$ in FY02 mostly to cover necessary electrical work.

The 2nd TEL to be installed in A0 sector. Specifics of the location is higher radiation level, so a special radiation shielding will be needed for the superconducting magnets of the 2nd TEL. Some 60K$ have to be allocated for that in FY02.

C. BBC Theory and Data Analysis

A number of theoretical and simulation topics remain to be studied, including: conditions of effective non-linear beam-beam compensation and the possibility of resonance strength reduction together with footprint compression; analysis and simulations of the higher than dipole-order modes in the pbar beam excited by head-tail interaction via the electron beam; and effects on and/or due to the proton beam.

M&S budget

Beam studies with the 1st TEL	25K$
Fabrication of the 2nd TEL	675K$
Testing the 2nd TEL in E4R	40K$
Preparing A0 location for the 2nd TEL	60K$
BBC Theory and Data Analysis	10K$
15% Contingency	120K$
TOTAL FY02:	**930K$**

Manpower

The BBC project group (Bishofberger, Kuznetsov, Zhang, Shiltsev) itself has man-power barely enough only for the beam studies with the 1st TEL and electron gun modification and vacuum/diagnostics designs. In addition, we need

1 Electrical Engineer and 1 Tech to fabricate/test QPS (R.Hively/H.Pfeffer and ??)
1 Electrical Engineer and ½ Tech to develop HV modulator (D.Wildman and ??)
1 Electrical Engineer and ½ Tech to develop other HV PSs (G.Saewert and ??)
1 Electrical Engineer to build beam diagnostics (J.Crisp)
1 Mech.Engineer – project engineer (J.Fuerst)
1 Drafter
½ CryoEngineer (A.Martinez)
½ Computer Specialist (??)
1 Scientist (Assoc.Sci. or higher) to carry out electron gun/collector diagnostic development/fabrication/test
1(or 2) Scientist(s) (grad student/RA) to take part in beam studies
2 Scientists (Ass.Scientist/Sci.I-II-III and RA) to carry out analytical and numerical studies of nonlinear BBC

LIQUID LITHIUM LENS R&D

We anticipate that BINP will continue to make slow progress and not have a working and tested high gradient liquid lithium lens in FY02. In the event they make a lot of progress, we will need considerably more money and manpower. If they have some level of success with their most recent version of the lens, it may make sense for J. Morgan and A. Leveling to visit IHEP to see the system operating.

We would like to have a total of $200k budgeted for FY 2002. $150k is to either pay for the completion of phase 4 of the accord or to give them another extension of phase 3. 30k is for shipping of the power supply, lens contour and lenses. $5k is for travel money. $15k is contingency.

We would only need about 0.2 FTE of engineering physicists (J. Morgan and A. Leveling) to check on technical progress at BINP and 0.1 FTE of a mechanical technician to continue to prepare AP0 for the power supply and pumping contour.

In the unlikely event BINP is very successful with the next lens test, a fully developed R&D effort would take $500k and about 7.0 FTE at Fermilab. Some of the labor time could be spread among existing target station personnel, but we could not proceed without two new mechanical engineers and a dedicated drafter.

ACCUMULATOR COOLING

Accumulator Cooling will stay at a fairly low level of effort in FY02. We will require about 0.8 FTE of a physicist (Derwent) to continue with simulation and design studies and 0.2 FTE of an RF engineer (Pasquinelli) to start preliminary RF designs and cost estimates. We anticipate no M&S costs in FY02.

DEBUNCHER LATTICE UPGRADES

The Debuncher Lattice Upgrade project will require two physicists (Werkema @ 0.8 FTE, Lebedev @ 0.2 FTE) working on beam studies in the Debuncher and simulation studies. We anticipate no M&S costs in FY02

TEVATRON BEAM DYNAMICS

We will require a physicist (Tan @ 0.5 FTE) performing preliminary beam studies in the TEVATRON. Some of these studies might require a small amount of RF electronics so we are also requesting $10k in M&S and technician help (Koch @ 0.1 FTE).

<u>LINAC ION SOURCE</u>

Ion source studies to possibly obtain higher intensity from the operating H^- ion sources is under way and will continue through FY02. Presently the Linac output to the Booster is ~55 mA requiring a H^- source output from the 750 keV Preaccelerator of ~80 mA. The ~30% loss is due to the maximum beam that can be captured into linac buckets even with an efficient Buncher in front of the Linac.

From studies of two years ago with a proton source, higher beam intensities were accelerated through and out of the Linac.

("High Current Proton Tests of the Fermilab Linac", with M. Popovic, L. Allen, A. Moretti, E. McCrory C.W. Schmidt and T. Sullivan. Proc. 20th. Int. Linear Acc. Conf., SLAC, Aug. 2000. http://arXiv.org/abs/physics/0008176).

At 80 mA from the Linac (~30% increase) all looked fairly well as though this is achievable although the radiation losses in the Linac were somewhat higher. At 90 mA the radiation levels were significantly higher and the RF systems were near a maximum. From this study, 80 mA appears to be the peak Linac output intensity. Allowing for a 30% loss for capture into the Linac the source output would need to be 114 mA.

For the next year the source effort will be to work: First with our normal magnetron H^- source to get higher intensity, second with a semiplanatron H^- source, and third with a Penning (Dudnikov) H^- source. The first probably requires the least amount of modification; the second two may achieve the desired intensity with a high brightness beam. All three sources are compact devices and have the potential of fitting to the preaccelerator column without a major modification of the column assembly, dome and dome electronics.

The test bench with necessary accessories exists and the magnetron H^- source already fits that assembly. The other sources will require some modification in mounting flanges and electronics. Some new diagnostics may be needed.

Manpower:

The manpower for this work already identified. The significant manpower is:

Scientific Staff		
1. Doug Moehs	Physicist	Full time
2. Chuck Schmidt	Physicist	Half time
3. Vadim Dudnikov	Guest Scientist	Half time
Technical Staff		
4. James Wendt	Specialists	Full time
5. Ray Hren	Specialists	Fulltime

FY02 Funds:

Since many of the major parts exist for this phase of the source work the funds are modest for this year. A general breakdown is:

Magnetron Source

Will need to make modifications and studies of the extraction, source magnetic field, gas valve, etc. $15k

Semiplanatron Source

Rebuild the source structure to fit the column assembly and test bench, and study its properties. $25k

Penning Source

Rebuild the source structure to fit the column assembly and test bench, and study its properties. $25k

Power Supplies

Improved arc and extractor supplies for better stability and higher current.

$30k

Diagnostics

Improved emittance probes and control diagnostics program.

$10k

Ion Source Software

Extractor modeling code

$ 3K

Total for FY02: $108K